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CARTOGRAPHIC DATA RETRIEVAL, ANALYSIS, DEPICTION, PRESENTATION AND PRODUCT GENERATION: SPECIFICATIONS AND STANDARDS

Mapping, charting and geodetic standardization activities within the United States Department of Defense

Paper submitted by the United States of America**

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** Prepared by Mel Wagner, Defense Mapping Agency.

The Defense Mapping Agency, as the responsible agency within the U.S. Department of Defense for Mapping Charting and Geodetic Technology, has undertaken a comprehensive program of standardization. This program addresses the user environment and utility software including standards for the exchange, display and manipulation of digital mapping, charting, and geodetic information for U.S. Department of Defense users. This paper describes current Defense Mapping Agency System Center initiatives within the standards program.

Introduction

The Defense Mapping Agency, as the responsible agency within the U.S. Department of Defense for Mapping, Charting, and Geodetic Technology, has established a comprehensive program of standardization. The goal of this research and development initiative is to develop a comprehensive suite of standards for the exchange, manipulation and display of digital data. The purposes of the program are to assure the compatibility and interoperability of digital mapping, charting, and geodesy data bases supporting a wide variety of simulators, command and control, navigation and weapon systems; to assure that data from different sources and from different collection techniques can be combined, processed and displayed in a common geographic reference frame; and to assure that two users performing the same or similar functions will get comparable results.

New Products on Compact Disc-Read Only Memory (CD-ROM)

There are a number of current R&D projects which support these goals. For example, in 1989 Defense Mapping Agency produced 460 CD-ROMs containing ARC Digitized Raster Graphic products, including rasterized versions of Operational Navigation Charts, Tactical Pilotage Charts and 1:50,000 scale Topographic Line Maps. 850 new CD-ROMs were produced in 1990. Our current schedule is to produce 1000 new CD-ROMs per year. World Vector Shoreline, formerly available only on magnetic tape, is now available on CD-ROM. A production capability for Digital Terrain Elevation Data has been established. All available Digital Terrain Elevation Data should be published on CD-ROM by April of 1990. In 1991, we intend to prototype on CD-ROM, the Electronic Chart Update Manual, Tactical Terrain Data, Interim Terrain Data, and Digital Navigation Publications.

Digital Products Study

In May 1990, the Defense Mapping Agency Deputy Director for Management and Technology commissioned the "Defense Mapping Agency Digital Products Study" to look at Defense Mapping Agency's standardization activities. The goal of this study was to provide a "framework for development of mapping, charting, and geodetic standards". Phase 2 of this study, begun in November and expected to last for 3 months, will provide an implementation plan for execution of this framework within an integrated environment. The scope of this study addresses U.S. Department of Defense weapons and system requirements, an assessment of commercial geographic information systems capabilities, data compression, media, ongoing map, chart, imagery and formatted text projects as well as the mapping, charting, and geodesy needs of the intelligence community. The framework that evolved from this study is a mapping, charting, and geodesy hierarchy of standards. At the very top of this architecture is the "Environment Level". Within

this level are the protocols which enable the algorithms and software at the lower levels to operate within the users environment. Included will be such things as standard operating system environments, standard query languages, presentation manager interfaces and graphics interfaces. This level represents standard platforms and operating system environments such as VAX, MacIntosh, PC and Sun workstations, standard languages such as FORTRAN and C, presentation managers such as X-Windows and standard query languages such as SQL. The Defense Mapping Agency will not drive these standards but we must insure that lower level standards which are developed are compatible with these standard environments.

The "Exploitation Level" will contain user oriented standard algorithms for such things as datum transformations, grid and projection generation, coordinate conversions, thinning and generalization, contouring, paneling and merging. This level is very important, for it is here where Defense Mapping Agency can have a tremendous impact. We must provide not only standard algorithms and software, but guidance on the proper applications, expected accuracies and selection criteria to choose the proper algorithms to satisfy user specific applications.

The "Data Directory Level" contains global information common across all product forms: tiling, indexing and cataloging schemes, recording history, spatial referencing schemes, accuracy, currency and legend information, as well as indices to aid the user in rapid access techniques.

At the "Product Level", the content, extent (coverage) and accuracy of specific products will be defined. Product Level standards also include delineation rules, capture and inclusion conditions, relations, procedural constructs and symbolization rules.

The "Data Dictionary Level" defines the spatial data structure (i.e. raster versus vector), and the feature coding scheme (i.e. glossary and lists of features and their attributes).

The "Format Level" describes the manner in which the physical organization of data is determined. For records, fields and sub-fields, the format defines the use of fixed versus variable lengths; the use of tags and delimiters versus constant position; the use of ASCII versus binary character coding; and the imbedding of the format description within the data set versus separate documentation.

The "Media Level" standards describe the volume labelling and physical characteristics of the transport media (i.e. magnetic tape, CD-ROM, etc.). Defense Mapping Agency will not influence standards at this level but will adopt pertinent industry standards such as ISO 9660 for volume labeling and Philips Yellow Book for the physical characteristics of CD-ROM.

Digital Chart of the World

Defense Mapping Agency's flagship effort for the development of vector product standards is called Digital Chart of the World. The goals of this initiative are: the development of exchange standards for all Defense Mapping Agency vector products; the demonstration of those exchange standards on a broad range of prototypes; development of software to display and manipulate data using the standards; and the production of a 1:1 Million scale product, suitable for geographic information systems applications. The Digital Chart of the World product is based on the existing 1:1 Million scale Operational Navigaiton Charts. It will be topologically structured, thematically separated and organized relationally. Digital Chart of the World will be distributed on CD-ROM. The final product will be available at the end of 1991.

Utility Software Development

Several initiatives are underway to assist the user in the import, display and manipulation of digital mapping, charting and geodetic information under the mapping, charting and geodesy utility software development program. The Common User Interface project will standardize the look and feel of interactive menus and standardize terminology used.

The Software Design project will establish conventions for the design, documentation and development of mapping, charting, and geodesy utility software.

The goal of the Symbol Development and Display project is to establish a mechanism for creation and exchange of standardized symbol libraries for display in a softcopy environment.

The current U.S. Department of Defense Glossary of Mapping, Charting, and Geodetic terms is being updated to include definitions of digital and geographic information systems terminology applicable to Defense Mapping Agency products.

A Handbook on Datum Transformations, Generation of Grids and Projections and Coordinate Conversions has been circulated for service review. This handbook provides guidance to users on selection of appropriate algorithms, expected accuracies and performance characteristics. A follow up to this project is an effort to establish U.S. Military Standards software employing the guidance of the handbook.

An Operations Concept for a library of utility software is under development which will identify how the software will be maintained and distributed, how configuration management will be performed and how information on available software will provided to the users.

1991 Research and Development Initiatives

All of the previous initiatives represent current activities. The following activities represent new starts for 1991 and beyond.

The goal of the Digital Map Data Comparison initiative is to demonstrate the proper application and uses of machine readable products. These demonstrations will highlight the differences, advantages, disadvantages and capabilities of Defense Mapping Agency vector, raster and video products. The Digital Products Study, mentioned earlier, identified a number of different compression techniques suitable for use on Defense Mapping Agency raster, vector and formatted text products. The study concluded that selection of a single compression methodology could not be done without a detailed analytical evaluation to test both the metric and visual effects of compression. The services have been invited to participate in this compression study. At the conclusion of the study, a single compression technique will be selected (for each product form) and applied to Defense Mapping Agency products.

Development of standards which describe the structure, format, content, etc. of new digital products will continue. Transition plans for the application of these standards to traditional Defense Mapping Agency digital vector, raster and formatted text products will be developed.

Efforts will also continue in the development of demonstration and display, translation and utility software for the import, display and manipulation of mapping, charting and geodesy data in the typical user environment.

The Defense Mapping Agency will also investigate the use of new media technologies, including Write Once Read Many, Very Large Data Storage, rewritable optical media, Videodisc and 8MM cassette.

We will also continue our support, both financially and through participation, to joint efforts within U.S. Department of Defense, other national and international agencies and academia. Some of these include: the Digital Geographic Information Working Group, National Center for Geographic Information Analysis, the Federal Geographic Data Committee (formerly Federal Interagency Coordinating Committee on Digital Cartography), National Science Foundation, National Institute of Science and Technology and the International Geodetic Symposium on Global Positioning Satellite.

Conclusion

In summary, Defense Mapping Agency has been involved in digital product standardization activities for more than a year. A study identifying and addressing major mapping, charting and geodesy issues concerning production, a hierarchy of mapping, charting and geodesy standards, compression, decompression, utility software, computer readable media, packaging and distribution, digital map displays, advanced products concepts and rapid prototyping capabilities will make important recommendations on the optimum uses of Defense Mapping Agency's digital products. This information will support our participation and coordination with national and international standardization organizations.

For further information of Defense Mapping Agency's Data Standardization program, contact:

Director
Defense Mapping Agency
ATTN: PRS (Mr. Frey)
8613 Lee Highway
Fairfax, Virginia 22031-2137
Telephone: (703) 285-9238

or

Director
Defense Mapping Agency Systems Center
ATTN: SGC (Mr. Wagner)
8613 Lee Highway
Fairfax, Virginia 22031-2138
Telephone: (703) 285-9257